

TITLE: Cross Section and Analyzing Power In The $^{206}\text{Pb}(\bar{\nu}, p) ^{208}\text{Pb}(4^-)$ Reaction

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SUBMITTED TO: Fifth International Symposium on Polarization Phenomena in Nuclear Physics, Santa Fe, August 11-15, 1980

MASTER

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CROSS SECTION AND ANALYZING POWER IN

THE $^{206}\text{Pb}(\vec{t},p) ^{208}\text{Pb}(4^-)$ REACTION*

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Cross sections and analyzing powers have been measured in the $^{206}\text{Pb}(\vec{t},p) ^{208}\text{Pb}$ reaction leading to the 4^- , 5^- , states of the $(p_{1/2}^{-1} g_{3/2})$ doublet. Standard DWBA calculations reproduce the cross section but not the analyzing power for the 5^- state. The opposite is true for a sequential transfer (t,d) (dp) calculation for the 4^- state.

Considerable effort has been directed at understanding the forbidden transition (1) in the $^{208}\text{Pb}(p,t) ^{206}\text{Pb}(3^+)$ reaction. Theoretical analyses have been able to reproduce the measured cross section assuming either a two-step sequential transfer reaction mechanism (2,3) or a single step process taking account of finite range effects and using a realistic wave function for the triton (4). Recently Toba et al (5), have also measured the analyzing power in this reaction at 22 MeV and have concluded that the data cannot be reproduced by a sequential transfer calculation. Thus the importance of two-step processes in this reaction remains in question. We have measured the cross section and analyzing power in the $^{206}\text{Pb}(\vec{t},p) ^{206}\text{Pb}$ reaction to the 4^- state at 3.475 MeV in an effort to determine the mechanism of such "forbidden" two-nucleon transfers.

Measurements were carried out at an energy of 17 MeV using the LASL polarized triton beam. Protons were detected with a helix counter in the Q3D magnetic spectrometer (6). Data were taken in 5° steps from 10° to 65° using the full angular aperture (14.3 msr) of the spectrometer. Only the results for transitions to the 5^- (3.198 MeV) and 4^- (3.475 MeV) states are reported here, though data were obtained for states between 2.5 and 4.9 MeV.

*Work supported by the U. S. Department of Energy.

Measured cross sections and analyzing powers for the two states of interest are shown in Fig. 1. Error bars on the data points indicate statistical uncertainties only. The uncertainty in absolute cross sections is estimated to be less than 20%.

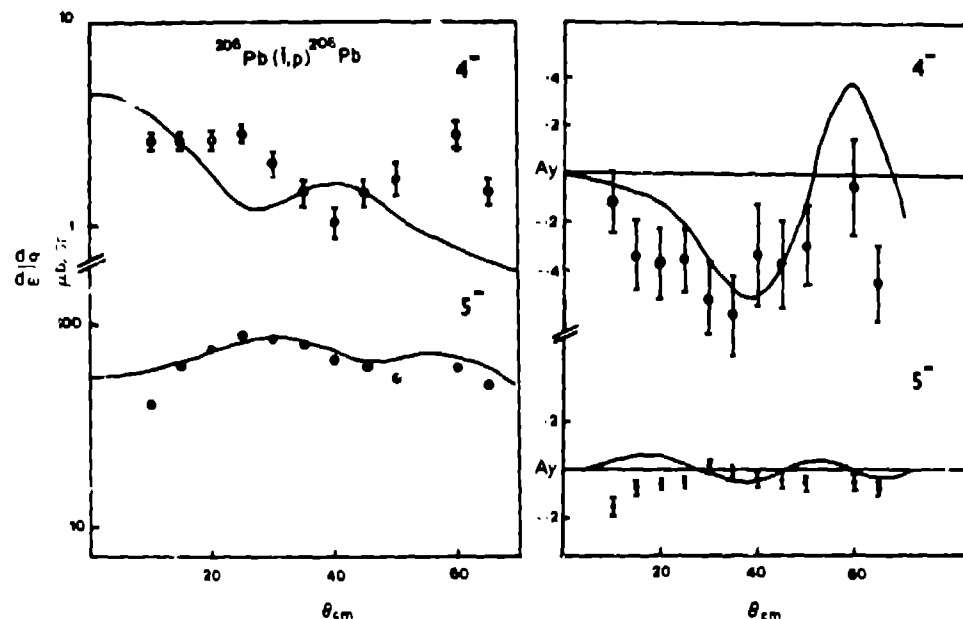


Figure 1 - Cross sections and analyzing powers for the 5^- (3.198 MeV) and 4^- (3.475 MeV) states in ^{208}Pb . Bars represent uncertainties due to counting statistics. The curves are the result of calculations described in the text.

The dominant component (7,8) of the wavefunctions of these states is $(p_{1/2}^{-1} g_{9/2})_{1/2}^-$. Thus our initial analysis of these results has assumed that these states are the two members of the $(p_{1/2}^{-1} g_{9/2})_{1/2}^-$ 4^- , 5^- doublet.

Reaction calculations were carried out using the code CHUCK (9) with optical model potentials shown in table I. All calculations assumed a zero range interaction. For the transition to the 5^- state, a single-step reaction was assumed with a form factor $(p_{1/2} g_{9/2})$ coupled to the $(p_{1/2})^{-2}$ component of the ^{208}Pb ground state. The transition to the 4^- state was assumed to proceed via a sequential (t,d) (d,p) reaction.

These calculations provide reasonable agreement with the measured angular distribution for the $L=5$ transition. The magnitude of the measured analyzing power is small, in agreement with the calculations, but the angular variation does not agree well. Similar results have been observed for large- L transitions in lighter nuclei (10). In contrast, for the 4^- state the theory predicts the general magnitude of the cross section, but does not reproduce the

angular dependence, while the theory shows fairly good agreement with the analyzing power data.

Possible reasons for the above discrepancies are two step contributions to the cross-section for the 5^- state, and additional contributions to both transitions from small components of the wave functions. Calculations are in progress to test these possibilities.

TABLE I
OPTICAL PARAMETERS USED IN REACTION CALCULATIONS

	V MeV	r_0 fm	a_0 fm	W_V Me	W_D MeV	r_1 fm	a_1 fm	V_{so}	r_{so}	a_{so}	r_c
p	-60.45	1.12	.78	0	7.1	1.32	.59	-6.2	1.0	.75	1.3
d	-98.1	1.10	.82	0	15.9	1.32	.71	-2.8	.98	1.0	1.3
t	-165	1.16	.752	-16.4	0	1.5	.82	-6.0	1.16	.752	1.3

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